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An update on the South African Pilot CO_2 Storage Project

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Abstract

South Africa is reliant on fossil fuels. These fossil fuels are important to economic development, being the most dependable, cost-effective energy source currently available in this country however, their conventional use results in significant CO_2 emissions for the country. South Africa will require a portfolio of technologies to reduce its CO_2 emissions however with a heavily coal-based economy, CCS is likely to be a particularly important part of this portfolio.

To assess the technical potential for CCS in South Africa, the South African Centre for Carbon Capture and Storage (SACCCS) was established in 2009 as a public-private research collaboration. The current focus of SACCCS is the development of the Pilot CO_2 Storage Project (PCSP) which will inject and store between 10-50,000tCO_2 in South African conditions.

With the development of the PCSP now underway, there has been significant progress to date, in particular in the areas of funding, permitting and stakeholder engagement where around USD 50 million has been raised for the project, a request for approval for basin exploration submitted, and a significant number of stakeholders engaged. There have however also been some delays with the development of the PCSP, particularly following the PCSP Advisory Committee (PAC) review of geological analysis done to date for the Zululand and Algoa Basins. The PAC recommended that more information could yet be extracted from the existing data prior to deciding whether or not to progress to the acquisition of new geological data (Gate 2 Review).

SACCCS is now working on the implementation of the PAC Review recommendations and the development of Gate 2 Deliverables in preparation for the Gate 2 Review.

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1. Introduction

South Africa is reliant on fossil fuels – approximately 90% of primary energy is derived from fossil fuels. Coal provides 92% of electricity production and, through synthetic fuel production, 30% of the petroleum used in South Africa [1]. This use of fossil fuels is important to our economic development, being the most dependable, cost-effective energy source currently available in this country. Fossil fuel production and use also provides significant employment in South Africa. The downside of fossil fuels however, is that their conventional use releases significant amounts of CO_2.

As with all countries, South Africa will require a portfolio of technologies to reduce its CO_2 emissions and meet its climate change goals. With a heavily coal-based economy, CCS is likely to be a particularly important part of this portfolio as one of the few technologies that can address the large-scale CO_2 emissions associated with coal-based electricity, liquid fuel production, smelter operations and cement production without negatively impacting the number of jobs and other social and economic benefits that these industries provide.

2. The South African Centre for CCS and the South African CCS Roadmap

To assess the technical potential for CCS in South Africa, the South African Centre for Carbon Capture and Storage (SACCCS) was established in 2009 as a public-private research collaboration. In parallel with the establishment of SACCCS, a roadmap for the development of CCS in South Africa was also developed which has five milestones. The Roadmap has since been endorsed by the South African Government Cabinet.

SACCCS's role in the South African CCS Roadmap is as follows:

2004	Assessment of the potential for CCS in South Africa
2010	Development of a South African CO_2 Geological Storage Atlas
2017	Commencement of a Pilot CO_2 Storage Project (10,000 - 50,000tCO_2 stored)
2020	Facilitate the commencement of a CCS demonstration plant (in the order of 100,000tCO_2/year)
2025+	Inform the implementation of commercial CCS deployment (over 1,000,000tCO_2/year)
Ongoing	Provide support to other CCS activities in South Africa

The South African CCS Roadmap milestones are dependent on finding suitable South African geology for CO_2 storage as well as receiving sufficient financial and technical support from Government, industry and international stakeholders.

3. The Pilot CO_2 Storage Project

With the *Atlas on Geological Storage of CO_2 in South Africa* [2] now complete, SACCCS is now focusing on the Pilot CO_2 Storage Project (PCSP) which will inject and store between 10-50,000tCO_2 in South African conditions. The primary aims of the PCSP are as follows:

1. Demonstrating safe and secure CO_2 handling, injection, storage and monitoring in South African conditions, in particular South African geology;
2. Increasing the South African human and technical capacity for the development and operation of CO_2 handling, injection, storage and monitoring;
3. Raising awareness of the potential importance of CCS to the South African public; and

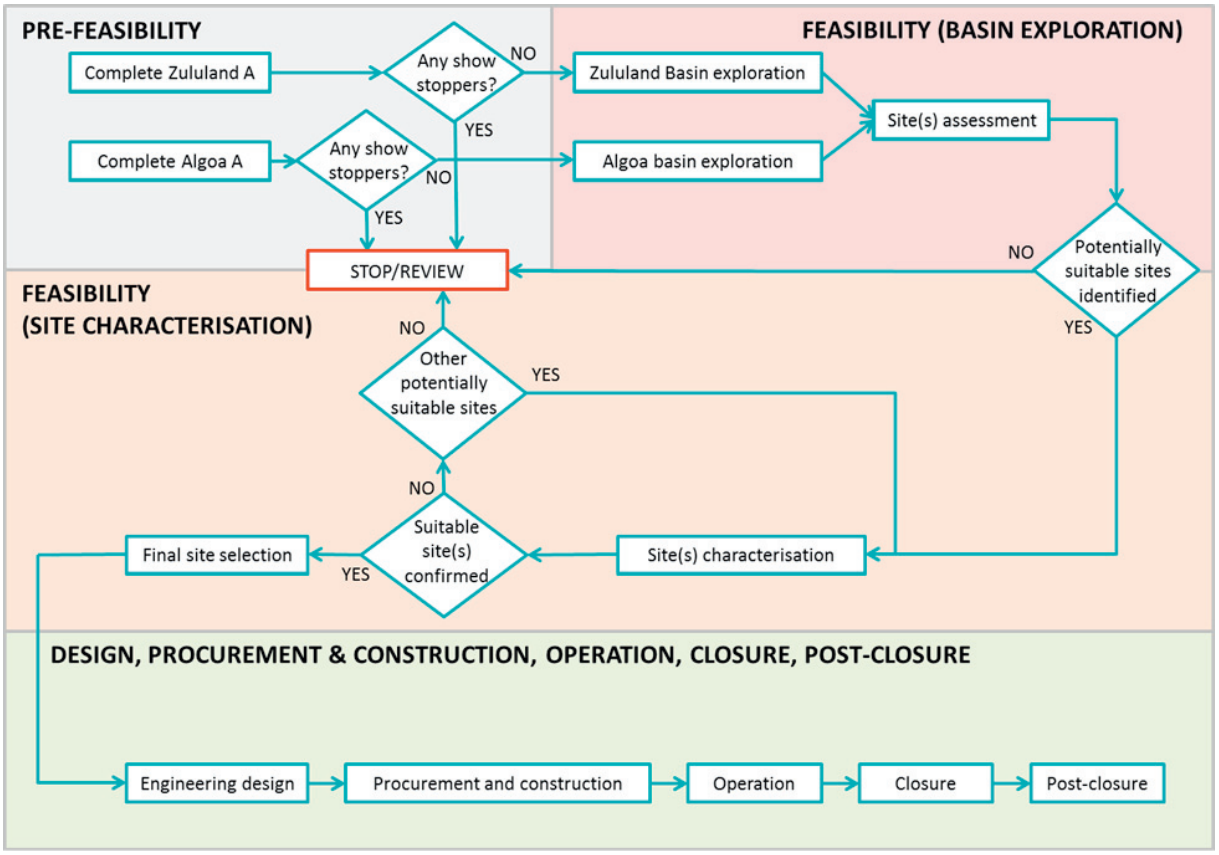
4. Working with government to ensure that the development and operation of the PCSP can occur within the South African legal and regulatory environment.

The delivery of the PCSP is divided into nine Stages separated by eight Gates (See Figure 1) with the PCSP currently in the Pre-feasibility Stage, working towards Gate 2. The work flow for the PCSP, including major decision points (Gates) can be seen in Figure 2.

Figure 1: The PCSP Stage-Gates

Stage 1	**Commencement**
	The official start to the project.
Gate 1	
Stage 2	**Pre-feasibility (*Current Phase*)**
	The review of existing information to understand the context of the project and if/how to proceed. Preparation for the feasibility stage including acquiring the necessary funds and permits.
Gate 2	
Stage 3	**Feasibility**
	The gathering of additional geological information through Basin Exploration and later Site Characterisation and engagement with CO_2 sources to enable the selection of site for the PCSP. Preparation for pre-operation stages including ensuring permits and sufficient funding are in place.
Gate 3	
Stage 4	**Schematic Engineering Design**
	Basic conceptual engineering design for the project. Baseline monitoring will also commence.
Gate 4	
Stage 5	**Detailed Engineering Design**
	Detailed engineering design for the project. Preparation for the procurement and construction, operation and decommissioning stages including ensuring necessary funds and permits are in place.
Gate 5	
Stage 6	**Procurement and construction**
	All infrastructure is purchased and construction is completed for the commencement of operation.
Gate 6	
Stage 7	**Operation**
	CO_2 sourcing, transport and storage commences either in one continuous process or as a serious of individual tests. Operational monitoring will also commence.
Gate 7	
Stage 8	**Closure**
	Post-injection monitoring, the removal of infrastructure and the acquiring of permits for the closure of the project.
Gate 8	
Stage 9	**Post-closure**
	The cessation of active project management and monitoring following the acquisition of the permits of closure.

Figure 2: The PCSP Stage-Gates



4. An update on PCSP progress

With the development of the PCSP now underway, there has been significant progress to date, in particular in the areas of funding, permitting and stakeholder engagement.

With regard to the funding, SACCCS has now had committed R197 million (~USD 18 million) for the PCSP by the South African Department of Energy. In addition, SACCCS has also seen the allocation of USD27 million to the PCSP from the World Bank and R25 million (~USD 4 million) from the Norwegian Government. The funds received from the World Bank come from the World Bank CCS Trust Fund and include a significant contribution from the United Kingdom Department of Energy and Climate Change. Following the allocation of the funds, SACCCS has commenced working with the World Bank to develop a Project Concept Note (PCN) detailing the application of the funds.

With regard to PCSP permitting, recently the project saw a major milestone met with the submission of a request for approval for a geological investigation (Basin Exploration and Site Characterisation) of the Zululand Basin to the South African Department of Mineral Resources. This submission followed extensive engagement with the Department of Mineral Resources (DMR), nationally in Pretoria and provincially in KwaZulu-Natal as well as other stakeholders relating to this process. SACCCS also solicited the support of the Council for Geosciences (CGS to support the ongoing process for approval including conducting any requirements with regard to an assessment of

environmental impacts of the project. It is understood that the permitting of Basin Exploration and Site Characterisation can be done under existing legislation – primarily the Minerals and Petroleum Resources Development Act. For the actual execution of the PCSP however, amendments to existing legislation and regulation and/or new legislation and regulations will be required. SACCCS is working closely with the Department of Energy and the Inter-Departmental Task Team on CCS to consider legislation and regulation for the operational stages of the PCSP.

Significant achievements have also recently been made with regard to PCSP stakeholder engagement. Building on the finalisation the National and Local Stakeholder Engagement Plans (Nat-Loc Plans) developed as part of the World Bank-Department of Energy CCS Study, a Communications Action Plan was finalised to provide a framework implementation of the plans.

The Nat-Loc Plans recommended that PCSP stakeholders should be engaged in the following order:

- National government
- Provincial government
- District Municipalities
- Local Municipalities
- Local stakeholders and the local community

This order was proposed to ensure the most important stakeholders were informed of the PCSP by SACCCS rather than hearing about it through less informed sources. SACCCS is now well advanced in the implementation of the Nat-Loc Plans with significant engagement having already taken place with National, Provincial, District and Local government officials as well as additional meetings with other key stakeholders such as Environmental NGOs. Each stakeholder engaged by SACCCS has had many questions around CCS and the implementation of the PCSP. However, on the whole, stakeholders have been supportive of the process with many offering to facilitate engagement with other relevant stakeholders as well as offering SACCCS to make use of their existing structures/resources.

Dispite this progress, there have however also been some delays with the development of the PCSP, particularly following the PCSP Advisory Committee (PAC) review of geological analysis done to date for the Zululand and Algoa Basins. The PAC comprises international CCS experts and was established to ensure decisions made with regard to the PCSP were informed by international best practice. At the first meeting of the PAC, they were asked, based on the analysis to date for the Zululand and Algoa basins, to advise on the likelihood that SACCCS will be able to identify a site for the storage of 10-50,000tCO_2 based on a number of constraints, including a proposed budget. The PAC in their review, complemented the depth of work done on the areas of interest however recommended that more information could yet be extracted from the existing data prior to deciding whether or not to progress to the acquisition of new geological data (Gate 2 Review), especially given the costs associated with such data acquisition.

SACCCS is now in the process of implementing the PAC Review recommendations and has established a national PCSP Storage Sub-Committee to oversee this work. This has resulted in a delay in the progress of the PCSP to Gate 2 however it is considered more important that the PCSP adheres to international best practice and the basis for the Gate 2 Review is complete.

5. PCSP next steps

The immediate next steps for the PCSP will be the implementation of the PAC Review recommendations and the development of Gate 2 Deliverables in preparation for the Gate 2 Review. Of particular focus will be the significant additional work is also required relating to the storage assessment of the Zululand and Algoa Basins. This work will include additional data mining to ensure all existing data relating to the Algoa and Zululand Basins has been identified, the analysis of this data in accordance with industrial standards including static and dynamic modelling, development of plays and subsequently leads; and, finally the development of an exploration plan for each lead.

From Gate 2, the progress of the PCSP will be dependent on the outcomes of the geological analysis and investigations and the views of the funders and stakeholders bearing in mind that uncertainty and risk is very difficult to constrain in a geological investigation and this uncertainty and risk need to be understood by the PCSP stakeholders and funders at all times.

References

[1] South African Department of Environmental Affairs. 2010. National Climate Change Green Paper, 14-15pp
[2] Cloete, M. 2010. Atlas on geological storage of carbon dioxide in South Africa. Council for Geoscience, Pretoria, South Africa